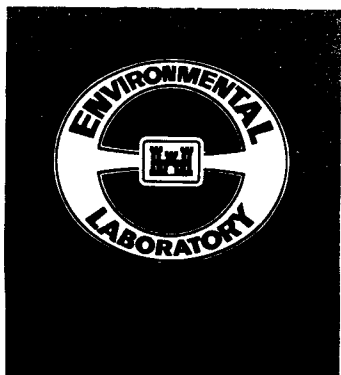
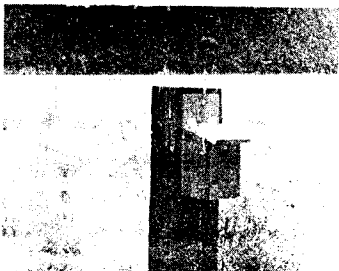
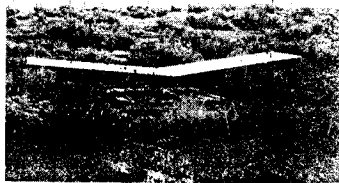
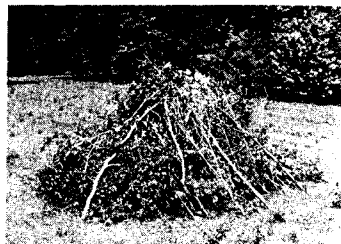




**US Army Corps
of Engineers**



ENVIRONMENTAL IMPACT RESEARCH PROGRAM

TECHNICAL REPORT EL-86-8

GALLINACEOUS GUZZLERS

Section 5.4.1, US ARMY CORPS OF ENGINEERS
WILDLIFE RESOURCES MANAGEMENT MANUAL

by

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July 1986

Final Report

Approved For Public Release; Distribution Unlimited

Prepared for DEPARTMENT OF THE ARMY
US Army Corps of Engineers
Washington, DC 20314-1000
Under EIRP Work Unit 31631

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SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE				Form Approved OMB No. 0704-0188 Exp. Date: Jun 30, 1986	
1a. REPORT SECURITY CLASSIFICATION Unclassified			1b. RESTRICTIVE MARKINGS		
2a. SECURITY CLASSIFICATION AUTHORITY			3. DISTRIBUTION/AVAILABILITY OF REPORT		
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE			Approved for public release; distribution unlimited.		
4. PERFORMING ORGANIZATION REPORT NUMBER(S)			5. MONITORING ORGANIZATION REPORT NUMBER(S)		
			Technical Report EL-86-8		
6a. NAME OF PERFORMING ORGANIZATION Washington Department of Game; USAED, Portland		6b. OFFICE SYMBOL (If applicable)	7a. NAME OF MONITORING ORGANIZATION USAEWES Environmental Laboratory		
6c. ADDRESS (City, State, and ZIP Code) Walla Walla, WA 99362 PO Box 2946, Portland, OR 97208			7b. ADDRESS (City, State, and ZIP Code) PO Box 631 Vicksburg, Mississippi 39180-0631		
8a. NAME OF FUNDING/SPONSORING ORGANIZATION US Army Corps of Engineers		8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER		
8c. ADDRESS (City, State, and ZIP Code) Washington, DC 20314-1000			10. SOURCE OF FUNDING NUMBERS		
			PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.
					WORK UNIT ACCESSION NO. EIRP 31631
11. TITLE (Include Security Classification) Gallinaceous Guzzlers: Section 5.4.1, US Army Corps of Engineers Wildlife Resources Management Manual					
12. PERSONAL AUTHOR(S) Johnson, Ted, and Jacobs, Ruth A. (Wilson)					
13a. TYPE OF REPORT Final report		13b. TIME COVERED FROM _____ TO _____		14. DATE OF REPORT (Year, Month, Day) July 1986	
				15. PAGE COUNT 23	
16. SUPPLEMENTARY NOTATION Available from National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.					
17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)		
FIELD	GROUP	SUB-GROUP	Guzzler Wildlife watering devices		
			Gallinaceous guzzler (Continued)		
19. ABSTRACT (Continue on reverse if necessary and identify by block number) A management techniques report on gallinaceous guzzlers is provided as Section 5.4.1 of the US Army Corps of Engineers Wildlife Resources Management Manual. The report was prepared as a guide to assist Corps biologists and resource managers in developing and implementing artificial watering systems for wildlife where water supply is a limiting factor. Topics covered include habitat considerations, design and construction, installation, fencing, maintenance, personnel and costs, cautions and limitations, and evaluation. The gallinaceous guzzler is a permanent self-filling watering device used to improve habitat conditions for wildlife in arid and semiarid regions. The technique is appropriate for habitat management programs for game birds such as California quail (<i>Callipepla californica</i>), Gambel's quail (<i>C. gambelii</i>), scaled quail (<i>C. squamata</i>), chukar (<i>Alectoris chukar</i>), ring-necked pheasant (<i>Phasianus colchicus</i>), and mourning dove (<i>Zenaida macroura</i>),					
20. DISTRIBUTION/AVAILABILITY OF ABSTRACT <input checked="" type="checkbox"/> UNCLASSIFIED/UNLIMITED <input type="checkbox"/> SAME AS RPT. <input type="checkbox"/> DTIC USERS			21. ABSTRACT SECURITY CLASSIFICATION Unclassified		
22a. NAME OF RESPONSIBLE INDIVIDUAL			22b. TELEPHONE (Include Area Code)		22c. OFFICE SYMBOL

DD FORM 1473, 84 MAR

83 APR edition may be used until exhausted.
All other editions are obsolete.SECURITY CLASSIFICATION OF THIS PAGE
Unclassified

18. SUBJECT TERMS (Continued).

Water management	Habitat development
Cistern	Habitat management
Upland game birds	Wildlife management
Gallinaceous birds	Management practices and techniques

19. ABSTRACT (Continued).

as well as game mammals and certain nongame species. The guzzler described in this report is used extensively by the Washington State Department of Game and the US Army Engineer District, Walla Walla, and consists basically of a fiberglass cistern and a galvanized metal collecting apron. Details are given on the design, construction, installation, and maintenance of the guzzler, and specification drawings and lists of materials required are provided. Guidelines are presented on the application of guzzlers as part of a broader habitat management program in which food, cover, and water conditions are improved and properly interspersed.

PREFACE

This work was sponsored by the Office, Chief of Engineers (OCE), US Army, as part of the Environmental Impact Research Program (EIRP), Work Unit 31631, entitled Management of Corps Lands for Wildlife Resource Improvement. The Technical Monitors for the study were Dr. John Bushman and Mr. Earl Eiker, OCE, and Mr. Dave Mathis, Water Resources Support Center.

This report was prepared by Mr. Ted Johnson, Washington Department of Game, Walla Walla, Wash., and Ms. Ruth A. (Wilson) Jacobs, US Army Engineer District, Portland, Oregon, under an Interagency Agreement with the US Army Engineer Waterways Experiment Station (WES). Mr. Chester O. Martin, Team Leader, Wildlife Resources Team, Wetlands and Terrestrial Habitat Group (WTHG), Environmental Laboratory (EL), WES, was principal investigator for the work unit. The authors wish to express appreciation to District biologists of the US Army Engineer Division, North Pacific (NPD), for their contributions and review of this report. Mr. E. Paul Peloquin, Division Wildlife Biologist, NPD, was instrumental in providing guidance and review. Design and construction specifications were provided by Mr. Blaise Gradine, US Army Engineer District, Walla Walla. The authors' experience and input from Mr. James R. Kosciuk and Mr. Lonnie E. Mettler, US Army Engineer District, Walla Walla, were the sources of information on costs and man-hours. Technical review was also provided by Mr. Martin, WTHG; Dr. Wilma A. Mitchell, WTHG; and Mr. Larry R. Marcy, Texas A&M University.

The report was prepared under the general supervision of Dr. Hanley K. Smith, Chief, WTHG, EL; Dr. Conrad J. Kirby, Chief, Environmental Resources Division, EL; and Dr. John Harrison, Chief, EL. Dr. Robert T. Saucier, WES, was Program Manager, EIRP. The report was edited by Ms. Jessica S. Ruff of the WES Publications and Graphic Arts Division (PGAD). Drawings were prepared by Mr. John R. Harris, Scientific Illustrations Section, PGAD, under the supervision of Mr. Aubrey W. Stephens, Jr.

At the time of publication, COL Allen F. Grum, USA, was Director of WES, and Dr. Robert W. Whalin was Technical Director.

This report should be cited as follows:

Johnson, Ted, and Jacobs, Ruth A. (Wilson). 1986. "Gallinaceous Guzzlers: Section 5.4.1, US Army Corps of Engineers Wildlife Resources Management Manual," Technical Report EL-86-8, prepared by the Washington

Department of Game, Walla Walla, Wash., and US Army Engineer District, Portland, Oregon, for the US Army Engineer Waterways Experiment Station, Vicksburg, Miss.

NOTE TO READER

This report is designated as Section 5.4.1 in Chapter 5 -- MANAGEMENT PRACTICES AND TECHNIQUES, Part 5.4 -- WATER DEVELOPMENTS, of the US ARMY CORPS OF ENGINEERS WILDLIFE RESOURCES MANAGEMENT MANUAL. Each section of the manual is published as a separate Technical Report but is designed for use as a unit of the manual. For best retrieval, this report should be filed according to section number within Chapter 5.

GALLINACEOUS GUZZLERS

Section 5.4.1, US ARMY CORPS OF ENGINEERS WILDLIFE RESOURCES MANAGEMENT MANUAL

HABITAT CONSIDERATIONS	4	MAINTENANCE	13
DESIGN AND CONSTRUCTION	5	PERSONNEL AND COSTS	13
The Cistern	5	CAUTIONS AND LIMITATIONS	14
Collecting Apron	8	EVALUATION	14
INSTALLATION	11	LITERATURE CITED	16
FENCING	12	APPENDIX	19

The gallinaceous guzzler is a permanent self-filling watering device used to improve habitat conditions for animals in arid and semiarid regions. The first guzzler was developed by Ben Glading, California Department of Fish and Game, for use by California quail (*Callipepla californica*); thus, the device was christened "Glading's Gallinaceous Guzzler" (Glading 1947, Edminster 1954). Since its conception the device has gained wide acceptance, and its application has broadened to include management for many other game birds such as Gambel's and scaled quail (*C. gambelii* and *C. squamata*), chukar (*Alectoris chukar*), ring-necked pheasant (*Phasianus colchicus*), and mourning dove (*Zenaida macroura*), as well as game mammals and certain nongame species (Galbreath and Moreland 1953, Edminster 1954, Yoakum et al. 1980).

The guzzler described in this report is used extensively by the Washington State Department of Game and the U.S. Army Engineer (USAE) District, Walla Walla, and consists basically of a fiberglass cistern and a galvanized metal collecting apron (Fig. 1); it is designed primarily for bird use but may also provide water for small mammals. Depending on availability of materials and labor, other designs or materials may be preferred. Refer to USDA Forest Service (1969) and Yoakum et al. (1980) for alternate designs.

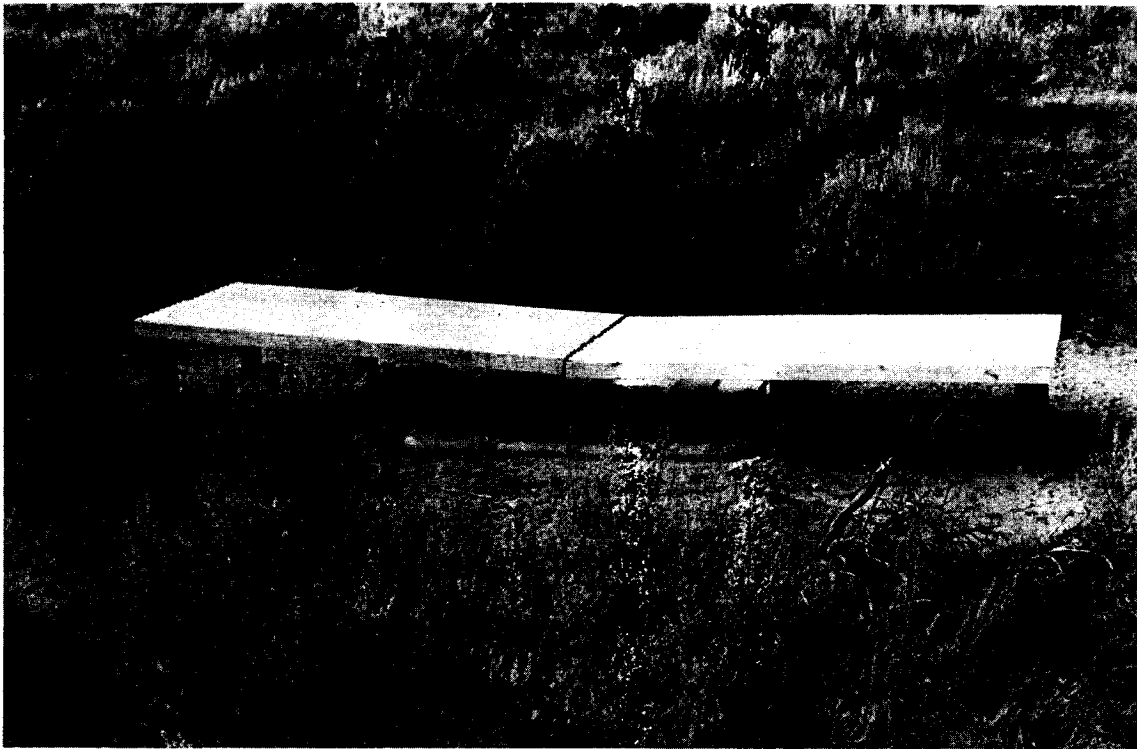


Figure 1. Gallinaceous guzzler installed for game bird use (photo compliments of Ted Johnson, Washington Department of Game)

HABITAT CONSIDERATIONS

The success of a habitat management program involving installation of a gallinaceous guzzler depends on (1) the condition of water, food, and cover within the managed area, and (2) the behavioral or physiological characteristics of a species that govern its use of an open water supply. If there is adequate food and cover, provision of water may be all that is needed to entice animals to occupy an area or to enhance production or survival of existing populations. If conditions are inadequate, a guzzler may be provided as part of a "guzzler complex" in which food, cover, and water conditions are improved.

Several basic principles should be considered when assessing the adequacy of existing habitat to meet an animal's needs or when planning habitat improvements: (1) food and water supplies should generally be close to cover; (2) several smaller areas that supply all of an animal's needs are usually better than one large area; and (3) a diversity of plant species and growth forms attracts a greater variety of animals and provides more

consistent food and cover for the target species (Burger 1973). These concepts should be considered when including guzzlers as part of a management program. Appropriate vegetation and distances between food, cover, and water will vary regionally and according to target species.

The appendix at the end of this section provides basic information on water requirements, movement patterns relative to water, and use of guzzlers for the scaled quail, Gambel's quail, California quail, mountain quail (*Oreortyx pictus*), gray partridge (*Perdix perdix*), chukar, ring-necked pheasant, blue grouse (*Dendragapus obscurus*), sage grouse (*Centrocercus urophasianus*), and turkey (*Meleagris gallopavo*). The information given in the table is intended only as a summary and does not apply to all situations; therefore, regional game specialists should be consulted for site-specific requirements.

DESIGN AND CONSTRUCTION

The guzzler described in detail below has 2 major features: (1) a concave cistern set in the ground, and (2) a double-section apron with inner sloping surfaces that sits above the cistern on wooden supports and collects precipitation for the cistern. Animals gain access to the water through an opening in the cistern and walk down to the water's edge via a ramp attached to the cistern's lid. The guzzler is functional, durable, easily constructed and installed, highly resistant to damage by livestock and big game animals, and requires little maintenance.

The Cistern

The guzzler cistern is prefabricated commercially and consists of a fiberglass tank and a removable reinforced fiberglass lid and ramp. Most companies that manufacture fiberglass products should be able to construct the cistern by following the plans and specifications provided in Figures 2-4.

Cistern tank. The tank is a concave bowl constructed entirely of fiberglass. Specifications provided in Figure 2 are for a 500-gal tank, but larger or smaller tanks can be constructed by modifying the design. Larger capacity tanks may be desirable to make water available for other uses such as fighting range fires, irrigating plantings, or providing drinking water for big game. Dimensions and thickness of the fiberglass parts shall be no less than 3/16 in. in thickness and 1 1/2 in. in any dimension. The form of fiberglass

casting to be used is hand-laid matting; casting the fiberglass with a chopper gun instead of hand-laid matting is cheaper but is not recommended because the fiberglass application is not uniform, air pockets may form, and the overall construction is weaker.

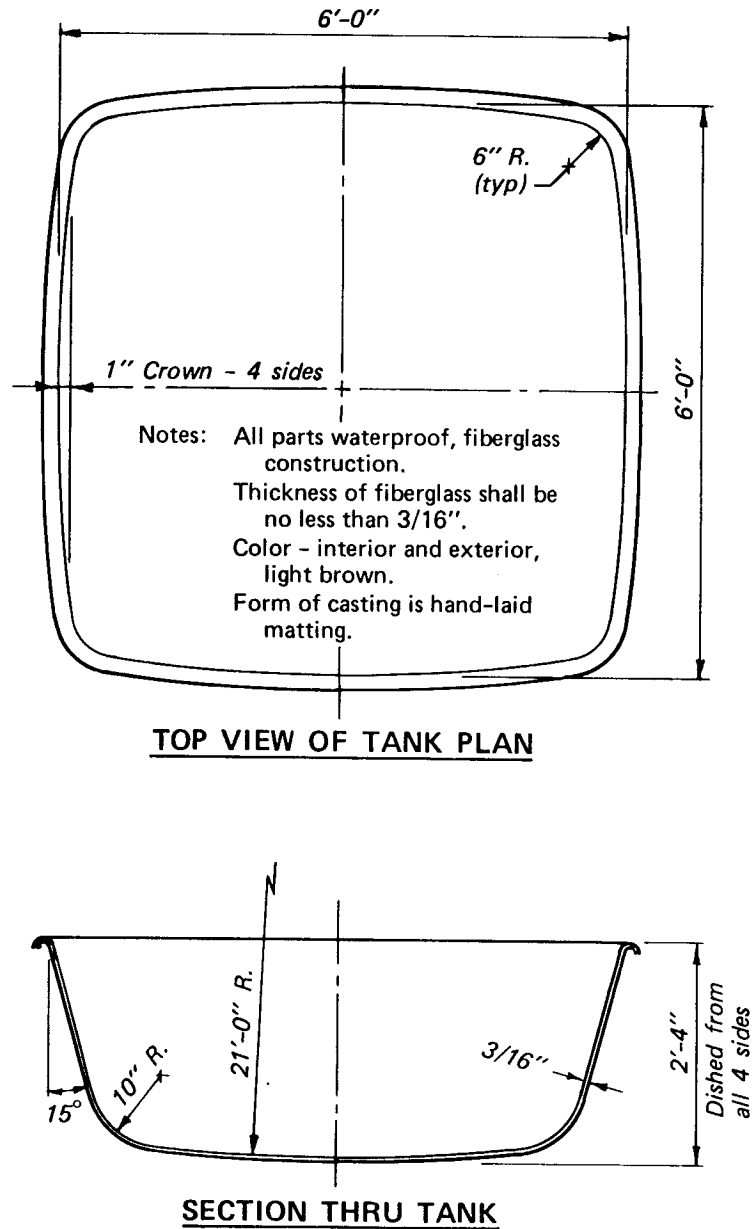


Figure 2. Construction details for commercially fabricated fiberglass cistern tank for a gallinaceous guzzler (after USACE 1979)

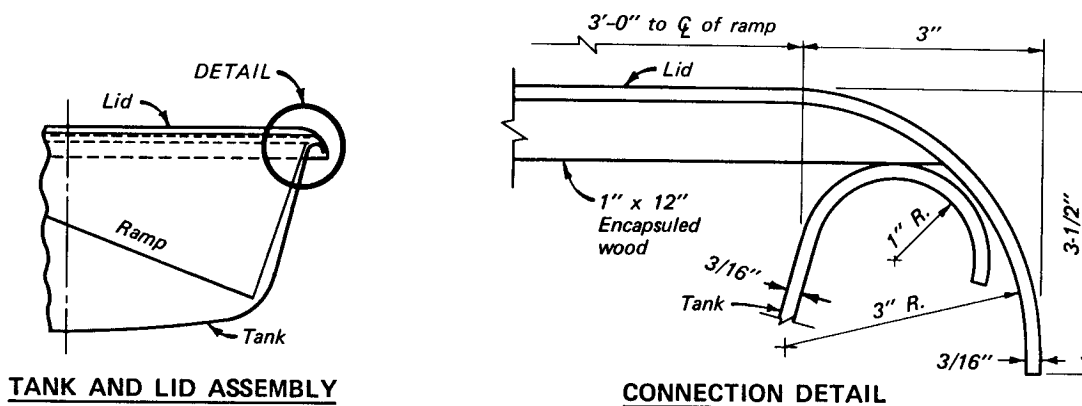


Figure 4. Construction detail for guzzler tank and lid connection (after USAEC 1979)

Lid and ramp. The lid covers the tank and provides access to water stored within the tank via an attached ramp. The lid is also prefabricated of fiberglass, with the color and form of casting usually the same as the tank (Fig. 3). Encapsulated wood or thickened fiberglass parts are included for strength to minimize damage if large animals walk across the lid. The lid fits snugly to the top of the tank (Fig. 4) and can be removed for cleaning and repairs.

Cistern molds. Most fiberglass companies can manufacture the cistern molds by following specifications provided in Figures 3 and 4. In the USAEC Division, North Pacific, the forms are owned by the Government but are stored at a local fiberglass company. The forms are thereby available to USAEC Districts or cooperating agencies that order cisterns from that company. Similar arrangements could be made by other USAEC Districts and Divisions on a regional basis for availability and storage of molds. Fiberglass manufacturers should be advised that curing cisterns at too rapid a rate, which can occur with high ambient temperatures, may damage the molds and products.

Collecting Apron

The collecting apron is made of sheets of corrugated galvanized metal roofing nailed to a set of wooden frames (Fig. 5, Table 1). The lumber should be stained with wood preservative to prevent splitting and dry-rot. The frames are 4 ft wide and made of 2- x 4-in. lumber nailed together at the corners. Framing anchors are attached to the corners of each frame to hold 90-deg angles and prevent joint expansion. The frames can be prefabricated

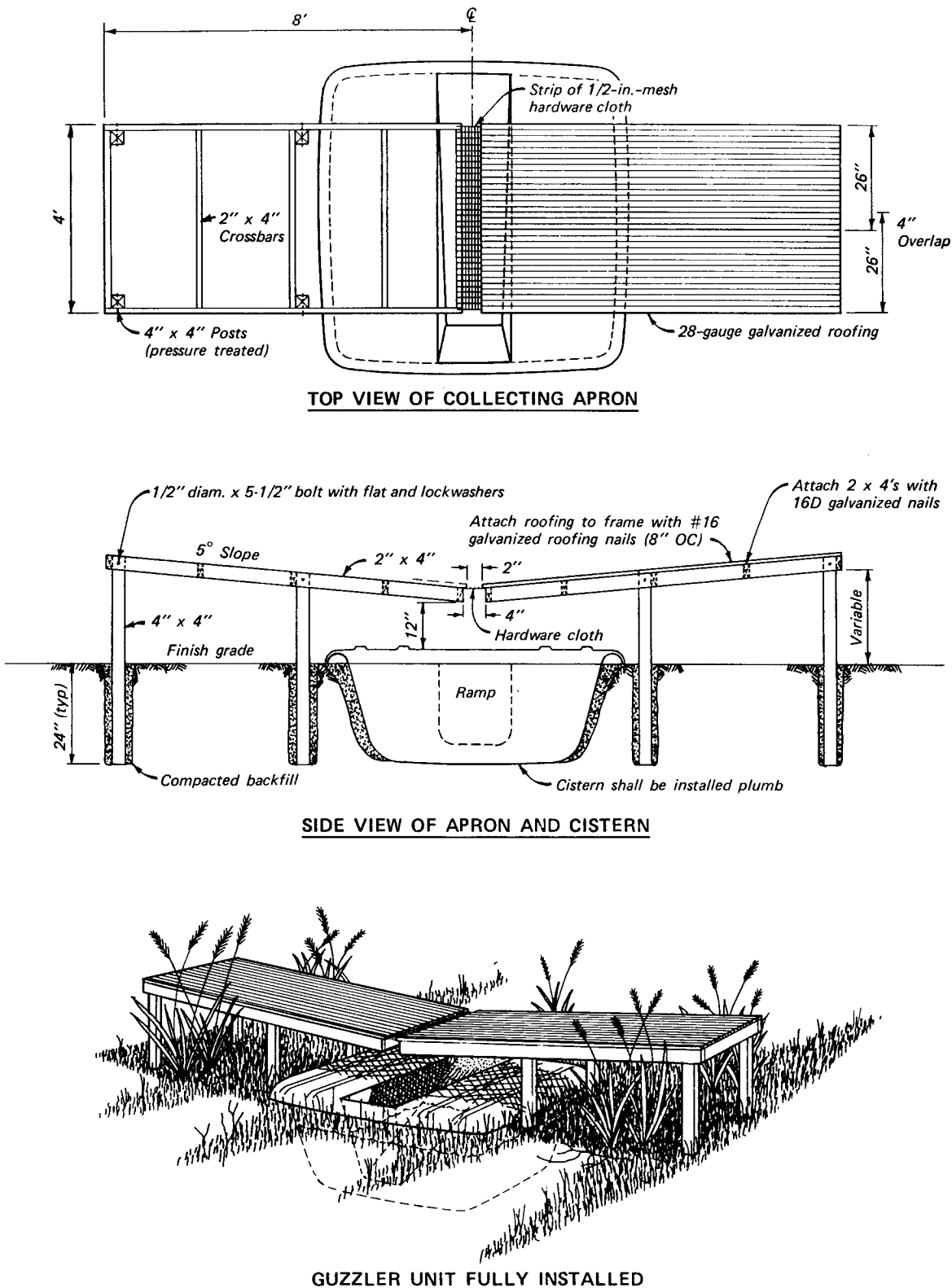


Figure 5. Construction and assembly details for the collecting apron, and installation guidelines for the completed gallinaceous guzzlers (after USACE 1979)

Table 1. Materials needed to build 1 gallinaceous guzzler collecting apron.
Lengths of 2- × 4-in. lumber for sides of frame and roofing will
vary depending on rainfall and size of cistern

Item	Quantity
<u>Lumber</u>	
4- × 4-in. × 4-ft pressure-treated wooden post	8
or 4-ft round cedar post split in half	4 or 8 halves
2- × 4-in. × 8-ft lumber	4
2- × 4-in. × 4-ft lumber	10
<u>Roofing</u>	
28-ga corrugated galvanized roofing, 26 in. wide	4 sections, 8 ft long
<u>Hardware</u>	
#16 galvanized nails	50
Galvanized roofing nails	60
1/2- × 5-1/2-in. galvanized bolts	8
1/2-in. galvanized flat washer	16
1/2-in. galvanized lock washer	8
4-in. × 4-ft strip 1/4-in. mesh hardware cloth	1
Galvanized framing anchors	8
Wood preservative	1 qt

and transported to the installation site intact. They are then bolted to wooden posts and oriented opposite each other above the cistern. The long axis of each frame is perpendicular to the long axis of the ramp, and the inside surfaces of the apron sections slope downward toward the ramp.

Two sheets of corrugated roofing, each 26 in. wide, are fastened to each frame to form the collecting surface. Thus, 4 sections of roofing are needed for each guzzler unit. Water flows from the apron sections onto the ramp and down into the tank. With this design, the apron also shades the cistern; additional sections can be added near a guzzler to provide shade for animals coming to drink.

The length of each apron section is a function of the area of collection surface needed to fill the cistern. The required surface area is a function of both the minimum annual precipitation expected at the installation site and the water capacity of the cistern. The area of a collecting surface can be calculated as follows (Yoakum et al. 1980):

$$\text{Area (sq ft)} = \frac{\text{Capacity of cistern (gal)} \times 1.6}{\text{Minimum level of rainfall (in.)}}$$

For example, a 500-gal cistern in an area with a minimum of 13 in. of rainfall would need a collecting surface approximately 62 sq ft. This surface area could be achieved with two 8- by 4-ft rectangular apron sections, an 8-ft square apron, or a circular apron with a diameter of 9 ft. Appropriate lengths of the 4-ft-wide corrugated roofing sections previously described are listed in Table 2. Information on precipitation levels is available in the U.S. Department of Commerce publication "Climates of the States." A separate publication is available for each State and can be ordered from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Reported levels of precipitation include rainfall and melted snowfall.

INSTALLATION

To install the cistern, first excavate a hole for inserting the tank; this may be done manually or with a backhoe. Compact and shape the soil on the sides and bottom of the hole to provide maximum support and contact area for the floor and walls of the cistern. In rocky areas the hole should be overexcavated and backfilled with sand or silt. The cistern is set into the hole, and any remaining space around the cistern's outside walls is filled with soil. The ground around the guzzler should be sloped to prevent silt and debris from being washed into the cistern. When the cistern is in place, the rim of the tank should be level and not more than 1 in. above the adjoining ground so that the lid will fit tightly over the tank. The lid is then placed over the top of the cistern.

The apron is situated above the cistern as shown in Figure 5. The steps below should be followed for ease of installation:

- (1) Hold prefabricated frame over cistern and mark locations of posts. The frames should be centered above the ramp opening with 2 in. of clearance between sections.
- (2) Dig holes and position posts nearest cistern to a depth that will allow 1 ft of clearance between the cistern lid and bottom of each frame.
- (3) Dig holes and position posts farthest from cistern to a depth that will create a 5% slope to the apron surfaces.
- (4) Drill holes for bolting frame to posts.
- (5) Bolt frames to posts; use flat and lock washers.

Table 2. Suggested lengths of wooden frames and corrugated roofing for a set of collecting aprons to achieve annual water yields under various levels of minimum annual precipitation (modified from Washington Department of Game (unpublished data) and Yoakum et al. 1980)

<u>Minimum Annual Precipitation, in.</u>	<u>Length, ft*</u>	<u>Potential Annual Water Yield, gal</u>
1	100	490
2	50	490
3	34	500
4	26	510
5	20	500
6	13	530
7	14	480
7	16	550
8	12	470
8	14	550
9	12	530
10	10	490
11	10	540
11	8	430
12	10	590
12	8	470
13	8	510
14	8	550
15	8	590
16	8	630
17	6	500
18	6	530
19	6	560

* Four sheets of roofing of equal length are used for a set of collecting aprons.

(6) Nail a strip of hardware cloth between sections of the apron.

(7) Nail sheets of galvanized roofing to frames.

Guzzlers are installed before the major rainfall period to ensure proper filling. Where heavy freezing occurs it may be desirable to install apron supporting posts that extend below the frost line so frost heave will not disturb the apron.

FENCING

Guzzlers are often fenced to minimize damage caused by livestock or big game animals walking on the cistern or rubbing the apron supports. Fencing can also protect native vegetation or plantings around a guzzler from

overgrazing (Emlen and Glading 1945). Fences should have gates to allow access for maintenance, and fence posts should be pointed to discourage perching by avian predators (USDA Forest Service 1969). Refer to Part 5.2 of this manual, Fences and Crossings, for specifications on a variety of fence designs.

MAINTENANCE

Guzzlers should be checked at least once a year. Debris such as sticks or leaves can be removed from the cistern via the ramp or by lifting the lid. A pump or siphon can be used to remove algae or silt. Fiberglass mat and epoxy resin can be used to patch holes in the cistern. Vegetation around the opening of the ramp should be cut back so that the ramp opening is not obscured. The collection surface can be increased by adding apron sections. With proper care, guzzlers can have an average life expectancy of 30 to 40 years.

PERSONNEL AND COSTS

The list of materials in Table 1 can be used to compute current costs of a guzzler. Cost of prefabricated cisterns (tanks and lids) purchased by the Yakima Firing Center, Washington, in 1981 was \$650 per unit (U.S. Army 1981). Reusable molds for fabricating cisterns were purchased in 1978 by the U.S. Army Engineer District, Walla Walla, for \$580 per unit.

From 3 to 17 man-hours are needed for guzzler construction and installation (not including time for commercial fabrication of the cistern and for travel to and from the installation site). The breakdown of the effort is: (1) 0.5 hour for constructing a set of wooden apron frames, (2) 0.25 hour for measuring and cutting corrugated roofing, (3) 0.25 hour for digging the hole if a backhoe is used, or 3 to 12 man-hours (i.e., 2 people each working 1.5 to 6 hours) if the hole is dug by hand, and (4) 2 to 4 hours for installation of the apron and cistern (2 people each working 1 to 2 hours). Fencing and plantings are an additional investment that must be calculated separately. Inspection and repair of a guzzler excluding fencing, plantings, and travel time will require from 0.5 to 4 man-hours.

CAUTIONS AND LIMITATIONS

Guzzlers should not be located in washes or gullies because of possibilities of flooding or siltation, and hard ground should be avoided as much as possible. The opening of a cistern should face opposite to prevailing winds and in a direction that minimizes exposure of the water to sunlight. Also, the collecting apron should not be overhung by branches that could interfere with interception of water and drainage.

As discussed earlier, food, water, and cover conditions must be evaluated at a site prior to guzzler installation. Campbell (1960) reported a situation where guzzlers were placed in areas of summer precipitation in New Mexico to improve conditions for production of Gambel's and scaled quail. However, broods dispersed to feed on succulent vegetation available in the summer and did not require open water to survive. On the average, only slightly over half the guzzlers were used by quail, and use was limited. Consequently, an expensive program was not justified in terms of increased production of young (Campbell 1960). This example is not provided to discourage consideration of use of a guzzler; rather, it is meant to emphasize the importance of evaluating an animal's needs and the ability of existing habitat to meet these needs before embarking on a program of guzzler installation.

Stocking programs are generally unnecessary to establish populations around a guzzler unless the desired species is absent and prevented from occupying the installation site due to existing barriers (Emlen and Glading 1945, Leopold 1977). For example, California quail 1 to 2 miles from a guzzler will find and use the water supply, although up to 3 years may be needed to attain maximum use (Edminster 1954). Despite attempts to improve habitat conditions, populations may be limited by terrain features or climatic extremes (MacGregor 1953) or by behavioral traits of a species, such as wide dispersion patterns. If such limitations occur, the decision to continue a guzzler program should be based on benefits to all species in an area, rather than those originally targeted for management.

EVALUATION

Guzzlers should be evaluated to determine animal use and impact on populations of target species. Direct observations of numbers and species, including animal sign, around the guzzler will provide basic information on

use. Determining impacts on population growth of target species may be difficult because the presence of animals at a guzzler site could reflect a concentration of surrounding populations rather than increases in a local population (Hungerford 1960).

Data collected on population or production levels within the managed area (the maximum radius of an animal's movement from the guzzler site) will determine whether specific management goals or mitigation requirements are being met; these data should be compared to a control area beyond the radius of movement. Relative or absolute data derived from variable circular plot censusing, flush or call counts, or nest searches (Overton 1971, Reynolds et al. 1980) can be used for this level of evaluation.

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APPENDIX

Generalized Information on Needs for Open Water, Movement Patterns, and Use of Guzzlers for 10 Species of Gallinaceous Birds

Species	Need for Open Water	Movements*	Information Specific to Guzzlers	References
SCALED QUAIL	Controversial; succulent vegetation, when sufficiently abundant, probably supplies needs	Movement to water dependent on abundance of succulent plants; reported to range 0.25 to 15 mi from water	Spacing intervals of 1.0 mi or more recommended; fence minimum of 0.5 acre (better 10-15 acres) with mostly grassy cover in fenced areas	Edminster 1954, Schemnitz 1961, Campbell et al. 1973
GAMBEL'S QUAIL	May require open water when succulent vegetation unavailable	Probably moves 1 mi or less to water in absence of succulent foods	4- to 5-mi spacing intervals recommended but coveys probably stay within 1 mi of water when succulent foods scarce; fence as for scaled quail but provide bushy cover	MacGregor 1953, Edminster 1954, Johnsgard 1973
CALIFORNIA QUAIL	May require open water when succulent vegetation unavailable	Young broods probably stay within 0.25 mi and adults within 0.5-1.0 mi of water in absence of succulent foods	Water supplies spaced at intervals of 1 mi or less recommended; brushy cover around guzzler needed and usually gained with fencing when rainfall sufficient	Emlen & Glading 1945, Edminster 1954, Leopold 1977
MOUNTAIN QUAIL	May require open water when succulent vegetation unavailable	Probably remains within 1 mi of water when succulent foods scarce or absent	1- to 2-mi spacing intervals recommended; brushy cover around guzzler important; mainly needed on low-altitude summer range; fence as for Gambel's quail	MacGregor 1953, Edminster 1954, Johnsgard 1973
GRAY PARTRIDGE	Open water probably not essential; usually sufficient supplies associated with food and cover	No major shifts between seasons; usually moves less than 0.25 mi, rarely up to 1 mi from water	Seldom nested over 0.1 mi from guzzlers placed near intermittently dry water-courses in Washington; 0.5-mi spacing interval used near Lower Snake River, Wash.	Porter 1950, Oliver 1969, Johnsgard 1973, USACE 1979
CHUKAR	Availability of open water during dry season influences distribution	Generally within 0.5 to 1.0 mi of open water when succulent food limited; may travel 2-3 mi to reach water	0.5-mi spacing interval used near Lower Snake River, Wash., with most nesting within 0.1 mi of guzzler; rocky slopes or brush needed near guzzler for escape cover or shade	Galbreath & Moreland 1953, Mackie & Buechner 1963, Oliver 1969, USACE 1979

(Continued)

* Information emphasizes movement relative to water supplies when possible.

APPENDIX (Concluded)

Species	Need for Open Water	Movements*	Information Specific to Guzzlers	References
RING-NECKED PHEASANT	Usually sufficient supplies associated with food and cover; may be inadequate supplies if land use practices exclude irrigation during dry season	Females can move up to 1 mi during breeding season; young broods probably remain within 0.1 mi of nest sites	0-5 mi spacing interval used near Lower Snake River, Wash.	Hart et al. 1956, Lauckhart and McKean 1956, Kuck et al. 1970, Hanson & Progulskie 1973, USACE 1979
BLUE GROUSE	Availability of open water probably limits movement of broods when succulent foods absent	Seasonal movements altitudinal; females with broods and territorial males move little; during prelaying and laying periods, adult females generally move less than 0.25 mi	May be beneficial on drier summer ranges; no specifics on spacing found	Johnsgard 1973, Hannon et al. 1982, USACE 1979
SAGE GROUSE	Open water used when and where available; can survive temporarily on succulent vegetation and dew; good habitat has good water supply	Seasonal (often altitudinal) movements from breeding to wintering grounds; females and broods can move 13-27 mi to rearing areas	Observed using guzzlers installed for other species	Edminster 1954, Dalke et al. 1963, Johnsgard 1973
WILD TURKEY	Open water necessary during warmer months; dew and succulent foods can supply some of needs	Typically moves to water daily; movement of 0.5-1.0 mi not unusual	No information found on guzzler installation specifically for wild turkey	Edminster 1954, Korschgen 1967